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Excavation of three badger (*Meles meles* L.) setts

By T. J. Roper, A. I. Tait, S. F. Christian and D. Fee

School of Biology, University of Sussex and East Sussex County Council, Lewes

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Abstract

Excavated and described three badger setts in the south of England. Two of the setts were classified as subsidiary setts and the third as an annex. Each consisted of a main network of interconnected tunnels associated, in two of the setts, with 2–3 small separate burrows. Total tunnel lengths were 28, 30 and 53 m respectively and estimated total volumes of the setts were 1.1, 1.1 and 2.1 m^3. No sett exceeded a depth of more than 1 m and mean depths of the tunnel systems were 61, 56 and 52 cm respectively. All three setts contained bedding material (dry grass) but only one (the annex) contained enlarged chambers, faeces and badger bones.

Introduction

One of the most striking features of the European badger is its habit of constructing complex underground burrows or "setts". Within the confines of their setts badgers sleep, breed, overwinter and take refuge when alarmed; and in addition the sett forms a focus for social interactions between the different members of a badger group (Neal 1977; Kruuk 1989). Although a few setts have been accurately described and mapped (Likhachev 1956; Jensen 1959; Cowlin 1967; Frewin 1976; Leeson and Mills 1977; Roper et al. 1991) we still know comparatively little about the structure or internal environment of setts; and little serious thought has been given to the question of why badgers need elaborate setts in the first place (for a recent review see Neal and Roper 1991).

In the present study we describe three setts that were about to be destroyed by a road development. Prior to excavating the setts in question an attempt was made to determine whether or not they belonged to separate social groups and whether they should be classified as main setts, subsidiary setts, annexes or outliers (Kruuk 1978; Bock 1986; Thornton 1988).

Material and methods

Study area

The excavated setts were located in open farmland immediately to the north-west of Brighton, about 3.5 km inland from the south coast of England. The landscape consisted of a range of rounded chalk hills (the South Downs) containing patches of permanent pasture and scrub (mainly hawthorn *Crataegus monogyna,* elder *Sambucus nigra,* blackthorn *Prunus spinosa* and brambles *Rubus* spp.) in between larger areas of arable planting (mostly of wheat *Triticum aestivum*).

Location of setts

A survey carried out in April 1989 revealed six setts falling into two separate spatial groups, one of four sets and the other of two (see Fig. 1). Of the group of four setts, sett 1 was by far the largest, having 9 entrances of which 7 showed clear signs of use. Setts 2 and 3, by comparison, had only 3 and 4 entrances respectively at the time of the survey, while sett 4 had a single entrance; and none of these setts appeared heavily used. Given their close proximity to one another it seemed likely that all four setts were within the territory of a single social group, and this was subsequently confirmed when the territory boundaries were mapped using the technique of bait-marking (Kruuk 1978).

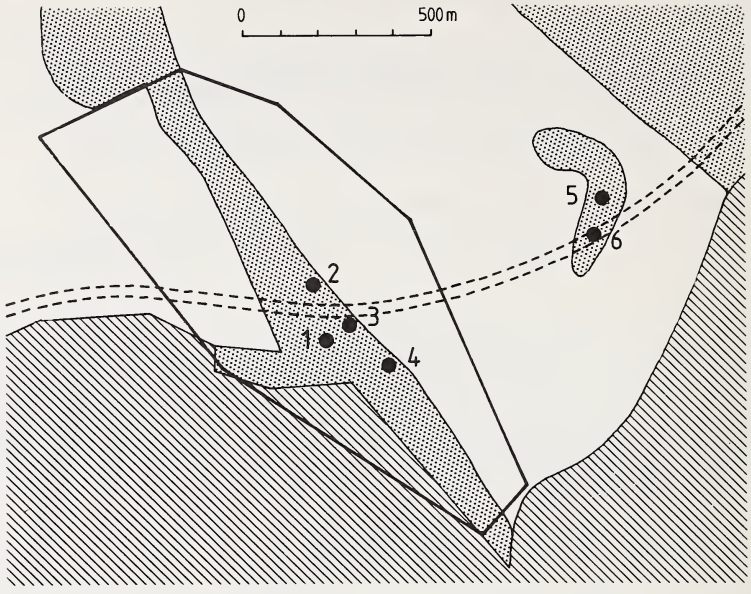

Fig. 1. Map of the study area showing position of setts (numbered 1–6). Dotted areas: grassland. Hatched areas: housing. Open areas: arable fields. Solid line: estimated territory boundary surrounding setts 1–4. Double broken line: route of new road

Of the pair of setts in the second group, sett 5 had 11 entrances of which 7 showed clear signs of use, while sett 6 had 5 entrances of which 4 showed clear signs of use. The two setts were connected by a well-worn path and although the territory boundaries surrounding the setts were not determined, it was clear from the proximity of the setts and their interconnectedness that both belonged to a single social group.

Of the six setts identified in Fig. 1 only setts 2, 3 and 6 were excavated since the remaining setts were not threatened by the new road. Setts 2 and 3 were located on a north-east facing slope, sett 2 at the top of the slope (altitude 95 m) and sett 3 near the bottom (altitude 80 m). Sett 2 was surrounded by dense scrub containing occasional mature sycamore trees *(Acer pseudoplatanus)*, while sett 3 was in open grassland dotted with occasional hawthorn trees *(Crataegus monogyna)*. Sett 6 was located on a west-facing slope at an altitude of 102 m in open grassland dotted with hawthorn trees. In all three cases the soil consisted of an open sandy loam to a depth of about 1.5 m, over chalk subsoil.

Method of excavation

The excavations were carried out in April 1990. Several months prior to this (in October 1989) all three setts were fenced off with one-way gates to exclude badgers from them (for a description of the method see Harris et al. 1988). When it was clear that the setts were no longer occupied the fences were removed and excavation was immediately begun.

The excavation itself was carried out with a small mechanical digger (Kibota KH20) or by hand when features such as tunnel intersections and nest chambers were encountered. Sett entrances were first identified with numbered surveyor's poles and plotted on a scale map. A 1.5 m-deep trench was then dug across one end of the sett, 2 m beyond the furthest entrance. The wall of the trench nearest the sett was gradually dug away, thus moving the trench progressively through the sett and exposing the underground tunnel system. As excavation proceeded tunnels and chambers were measured and plotted on a scale map, and the depth of the floor of each tunnel relative to the soil surface was measured to the nearest 10 cm, at intervals of approximately 2 m.

The length of each sett was measured as the furthest distance between any two extremities of the tunnel system. Sett width was measured orthogonal to the line joining these two points. Sett volume was calculated from the dimensions of tunnels and chambers, using the formulae of Leeson and Mills (1977).

Table. Dimensions and contents of the three excavated setts

Sett No.	Length (m)	Width (m)	Estimated volume (m^3)	Total tunnel length (m)	Mean tunnel depth (cm)	Entrances	Chambers	Bedding	Latrines	Badger remains
2	18	6	1.1	28	61	8	0	1	0	0
3	8	7	1.1	30	56	7	0	2	0	0
6	21	8	2.1	53	52	10	3	4	0	1

Results

The Table summarises the dimensions and contents of the three setts and Fig. 2 shows a plan view of each sett.

Sett 2

This consisted of four separate burrow systems, with tunnels totalling 28 m in length. Three of the burrows consisted of simple shallow tunnels only a few metres long, with single entrances, all of which were disused. The fourth system was larger and more complex, consisting of an interconnected network of tunnels radiating off from a central entrance, with four additional entrances around its outer limits. Two of the latter entrances were disused.

No obvious chambers were found, though tunnels tended to widen out where they intersected. Nor was there any evidence of badger faeces or badger remains (bones, teeth etc). A small amount of bedding material was found at one point in the main tunnel system, consisting of dry grass (about 1 litre) together with several chocolate wrappers and potato-crisp packets. Several of the tunnels had been extended by rabbits and at one point the excavation disclosed a rabbit nest containing four juveniles.

Sett 3

Sett 3 consisted of a single burrow system totalling 30 m in length, with four open entrances and three disused entrances. The system was essentially two-dimensional, with almost all tunnels running at a depth of 55–65 cm below the soil surface. The general plan of the system was of a single central tunnel forming the long axis of the sett, off which ran, more or less orthogonally, a number of separate tunnels.

The sett contained no enlarged internal chambers but a small amount of nest material (about 1 litre of dry grass) was found at two points where intersecting tunnels widened out. There were no badger faeces or other remains.

Sett 6

This sett consisted of three separate burrow systems: a single short burrow, 1.5 m long, with one entrance; a W-shaped burrow, 10.5 m long, with two entrances; and a larger interconnected network of tunnels, totalling 41 m in length, with five open and two blocked entrances. The two small burrows were separated from the large one by a distance of 8 m. Tunnel depths varied from 30–80 cm.

The large burrow system contained four distinct chambers which were the shape of a squashed sphere, 60–70 cm in diameter and 40–50 cm in height, with bowl-shaped floors. From their shape and symmetry, and the smoothness of their

walls, these were easily distinguished from other places, such as intersections, where the tunnel system widened out. One chamber was empty; the others contained small amounts of dry grass. In addition bedding material (dry grass) was found in one of the tunnels. A single deposit of faeces was found near one of the chambers containing bedding.

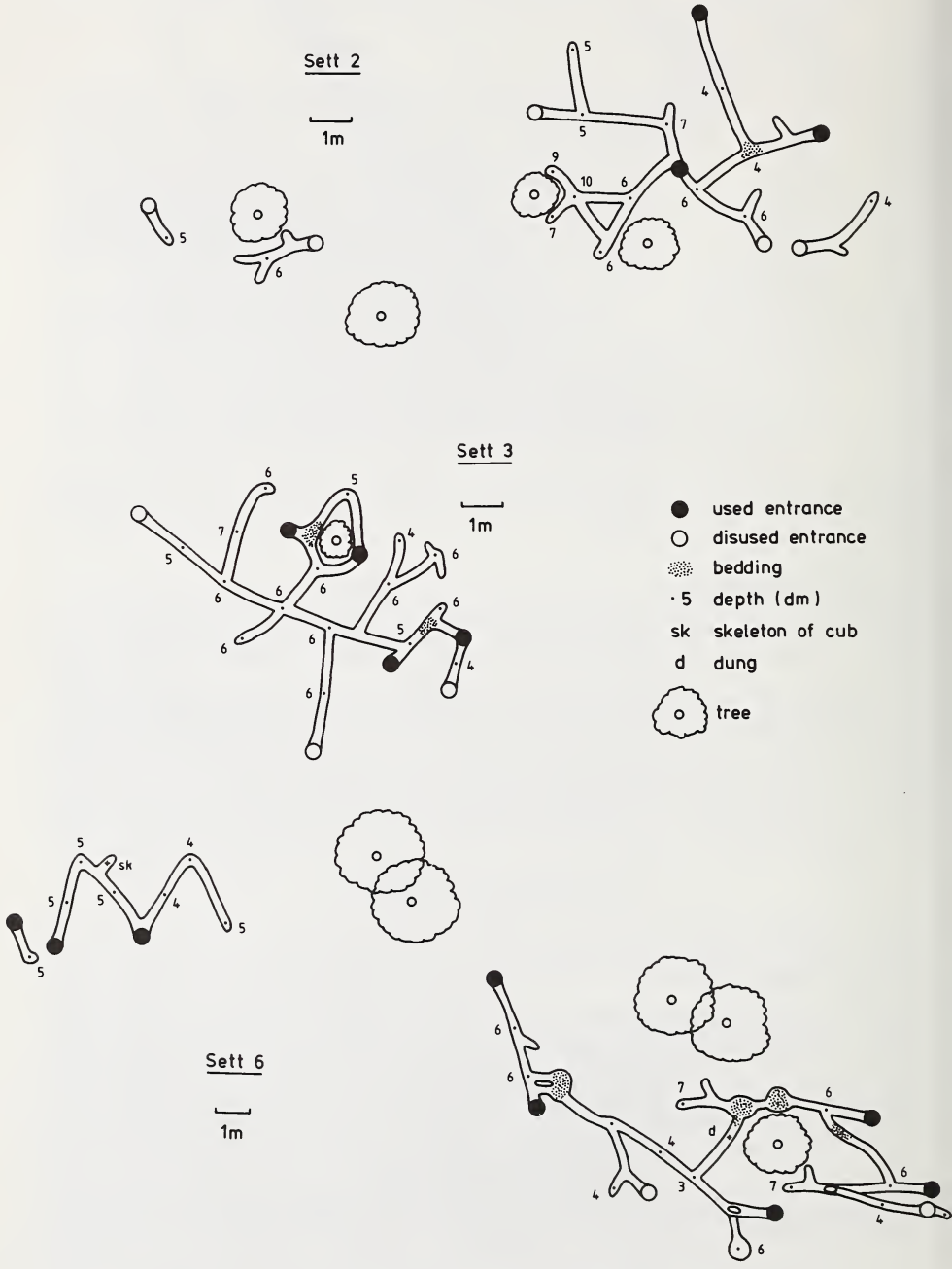

Fig. 2. Plan of setts 2, 3 und 6

No badger remains were found in the large system, but the skeleton of a cub was recovered from the small W-shaped burrow.

Discussion

A comparison of the architecture of the three setts reveals some striking similarities but also a number of differences. As regards the similarities, all three setts had tunnels of about the same size and shape (ie, about 25 cm wide × 15 cm high, with an arched roof and flattened floor), running at about the same average depth (50–60 cm). All three setts were essentially two-dimensional: only at two points in sett 6 did tunnels join in the vertical plane. All three setts had multiple entrances, some of which were disused; all three contained at least one nest of dry grass; and all three showed signs of occupation by rabbits as well as badgers. On the other hand, sett 3 consisted of a single burrow system whereas setts 2 and 6 also included two or three small separate burrows; and setts 3 and 6 each had a clear longitudinal axis running orthogonal to the slope into which they were dug, whereas sett 2 was roughly circular in plan. Furthermore, only sett 6 contained enlarged chambers, faeces and badger bones.

In explaining these similarities and differences at least three factors are relevant. First, certain features of badger setts, most notably their two-dimensional character and the size and shape of tunnels and chambers, show little variation from sett to sett (compare the present results with those of Likhachev 1956; Jensen 1959; Cowlin 1967; Frewin 1976; Leeson and Mills 1977; Roper et al. 1991). These sett characteristics may result from stereotyped, species-typical aspects of badger digging behaviour. Second, some features of setts, such as their size, complexity and depth depend at least in part on the nature of the soil in which they are dug (Bock 1988; Neal and Roper 1991). That these features were similar in the three setts described here would not then be surprising, given that all three were constructed in similar soil.

Third, there seems little doubt that badgers dig different types of sett for different purposes. Thornton (1988) distinguishes four types of sett: main setts, annexes, subsidiary setts and outliers. A "main sett" is a permanently occupied sett with many entrances and large spoil heaps; an "annex" also has many entrances but is not permanently occupied and is within 150 m of a main sett, to which it is connected by a well-used path; a "subsidiary sett" has fewer entrances, is not always occupied and is not obviously connected with a main sett; and an "outlier" has only one or two entrances and is only occasionally occupied. (See also Likhachev 1956; Neal 1977; Kruuk 1978 for similar attempts to classify setts in terms of size and use.) Applying these criteria to our three setts, we conclude that setts 2 and 3 were subsidiary setts. Thus, they were within the territory of an obvious main sett (sett 1, see Fig. 1), both had several entrances, but neither was regularly occupied. Sett 6, by contrast, seems to have been an annex: it was close to a larger main sett (sett 5), was linked to this main sett by an obvious path and was continuously in use in the year prior to excavation.

While it is agreed that main setts form the permanent home of a social group and are used for breeding and overwintering, the functional significance of annexes and subsidiary setts is less clear. Of our three setts only the annex contained nest chambers and latrines, suggesting that annexes may be better fitted for permanent or semi-permanent occupation (see also Roper et al. 1991). In addition the annex contained the skeleton of a cub. These observations are consistent with the idea that annexes are used for breeding by subordinate members of a social group, who may risk being attacked by a dominant animal if they remain within the main sett (Neal 1977).

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Zusammenfassung

Die Struktur dreier Baue des Dachses (Meles meles L.)

In den South Downs nordwestlich von Brighton in Südengland wurden drei Dachsbaue ausgegraben, vermessen und kartiert. Alle drei Baue bestanden aus einem Netz von Röhren, die bis 80 cm tief unter der Erdoberfläche verliefen. Alle enthielten trockenes Gras, aber nur in einem Bau fanden sich ein Kessel, Kot und Knochen eines Dachses, eines Jungtiers. Die Tunnellängen betrugen 28, 30 und 53 m, die Volumina der Baue 1.1, 1.1 und 2.1 m^3, die Zahl der Eingänge war 3, 4 und 5.

Offenbar war keiner der Baue ein Hauptbau. Vielmehr war der größte von ihnen offenbar ein auch als Wurfbau genutzter Nebenbau, die beiden übrigen waren separate Ergänzungsbaue.

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Authors' addresses: Dr. T. J. Roper, S. F. Christian and D. Fee, School of Biological Sciences, University of Sussex, Brighton BN1 9QG, UK; Dr. A. I. Tait, East Sussex County Council, Southover House, Southover Road, Lewes BN7 1YA, UK